SUMMARY

Northpoint's *Petition* seeks minor rule modifications that would enable DBS providers and their affiliates to offer the full range of local television stations, as well as data services, finally leveling the playing field for DBS providers to compete with cable operators. By solving the local signal problem, Northpoint's patented system will jumpstart competition in the multichannel video program distribution market, resulting in lower rates and increased program variety for consumers nationwide. Northpoint has estimated that the economic benefits of its system could save consumers over $3 billion annually. Moreover, providing DBS customers with local television programming and data offerings would promote valuable Congressional and Commission policies directed to advancing localism and public service.

The fundamental premise of the Northpoint system is to complement existing DBS programming. Thus, Northpoint shares the concern of DBS providers that its technology avoid any harmful interference to DBS subscribers. Accordingly, attached hereto is a Technical Annex that provides a link budget and interference analysis for a typical Northpoint terrestrial facility, including its impact on all DBS systems. The Technical Annex clarifies a number of misunderstandings regarding sharing between Northpoint and satellite-originated programming, most notably the level of protection to be afforded to DBS signals. While Northpoint determined in its first experimental test that the operational Carrier-to-Interference threshold is 4.8 dB, Northpoint's typical system would, in fact, naturally provide 20 dB -- the level identified as necessary by a number of DBS licensees.

The Technical Annex also demonstrates that Northpoint terrestrial transmitters and DBS signals can co-exist without harmful interference. Without even employing site-specific

engineering, the natural operation of the Northpoint system automatically provides 20 dB of C/I protection to DBS in 99.5 percent of the geographic service area of the transmitter. The remaining 0.5 percent of the service area (which would be engineered to cover far less than 0.5 percent of the population), can be further reduced by increasing tower height and beam tilt or eliminated through site specific engineering techniques. Moreover, a number of additional methods can be used by terrestrial licensees—at their own expense—to eliminate interference to the very few subscribers still potentially affected by the Northpoint system.

Northpoint's reply also addresses the opposition of SkyBridge, which is founded upon incorrect interpretations of both domestic and international law. Under domestic law, Northpoint has sought a status secondary to DBS and existing fixed services in the band. However, under international law, regardless of whether Northpoint's system is classified as a broadcast service or a fixed service, it is co-primary with nongeostationary fixed satellite services, such as the SkyBridge system. Northpoint is participating in international study groups to develop reasonable sharing criteria for the 12.2-12.7 GHz band, consistent with ITU allocation policies. Because SkyBridge has represented in its application that it will not impose any operational constraints on satellite or terrestrial operators, its position now that Northpoint will almost certainly interfere with its system is especially troubling.

As documented herein, Northpoint's system will not interfere with existing or future DBS subscribers. Moreover, to the extent any limited technical issues remain, these can be fully addressed in the context of the further experimental testing proposed by Northpoint in Austin, Texas. Given the vast public interest benefits promised by Northpoint's technology, the Commission should take all necessary action to expedite the rule making requested herein.

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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	
NORTHPOINT TECHNOLOGY	)	RM No. 9245
	)	
Petition for Rule Making To Modify Section 101.147(p) of the Commission's Rules To Authorize Subsidiary Terrestrial Use of the 12.2-12.7 GHz Band By Direct Broadcast Satellite Licensees and Their Affiliates	)	

REPLY COMMENTS OF NORTHPOINT TECHNOLOGY

Northpoint Technology ("Northpoint"), by its attorneys, hereby replies to the comments on its Petition for Rule Making.[1] The *Petition* introduced a new sharing technology that promises to allow Direct Broadcast Satellite ("DBS") providers to compete fully with cable television services by offering DBS customers a full line up of local television broadcast signals and other data services. Because Northpoint has sought to work in partnership with DBS licensees, Northpoint shares their desire to ensure the integrity of DBS offerings. This reply, accordingly, includes a Technical Annex that clarifies the proposed operation of its technology, resolving all legitimate interference concerns.[2] The technical analysis can be further validated by Northpoint's proposed Austin, Texas test of its technology, for which an experimental

[1] Northpoint Petition for Rule Making To Modify Section 101.147(p) of the Commission's Rules To Authorize Subsidiary Terrestrial Use of the 12.2-12.7 GHz Band By Digital Broadcast Satellite Licensees and Their Affiliates, RM 9265 (filed Mar. 6, 1998) ("*Petition*"). See FCC Public Notice, Report No. 2265 (Mar. 19, 1998).

[2] See Attachment A ("Technical Annex").

application is pending. Given the significant public interest benefits to result from deployment of the Northpoint system, the Commission should move forward expeditiously to initiate the rule making requested herein.

I. NORTHPOINT TECHNOLOGY WILL COMPLEMENT THE DBS SERVICE, SOLVING THE MOST VEXING COMPETITIVE PROBLEM IN THE MULTICHANNEL VIDEO PROGRAM DISTRIBUTION MARKET

As explained in the *Petition*, Northpoint's patented technology was developed finally to enable DBS to compete fully with cable television. By providing a means for DBS providers to offer the full panoply of local television signals as well as data services, Northpoint's technology removes the biggest impediment to competition in the multichannel video program distribution marketplace. Northpoint has estimated conservatively that the benefits of its system could save American consumers over $3 billion annually. Its technology is also the only local signal distribution system for DBS that preserves the substantial investment in consumer equipment made by the 8 million current U.S. subscribers to DBS service.

The Northpoint system achieves its public interest benefits in partnership with DBS providers. Because Northpoint views its technology as adding value to—and not replacing—core DBS offerings, the fundamental premise of Northpoint's technology is to avoid any adverse impact on DBS reception by subscribers. Accordingly, Northpoint takes very seriously *any* threat of harmful interference and is committed to working with each and every DBS licensee to resolve all legitimate technical concerns regarding co-existence of satellite and terrestrial signals. Northpoint has, accordingly, attached a comprehensive Technical Annex to these comments that fully answers the questions raised in the filings on the *Petition*.

II. NORTHPOINT TECHNOLOGY IS ENGINEERED TO ELIMINATE THE POTENTIAL FOR ANY ADVERSE IMPACT ON CONSUMER DBS RECEPTION

Northpoint's patented technology is designed to: (i) provide a commercially reasonable reliable service area; while (ii) minimizing interference to co-frequency DBS systems. Northpoint will achieve these goals by deploying a terrestrial transmission infrastructure engineered to take advantage of site specific engineering and other considerations that minimize any necessary signal "mitigation" area.[3] Attached to this reply is a Technical Annex providing Northpoint's proposed link budgets and interference analysis consistent with the 20 dB Carrier-to-Interference ("C/I") ratio advocated by DBS operators as necessary to protect their operations. As demonstrated therein, even without the use of site specific engineering, a typical Northpoint system will naturally achieve a C/I ratio of 20 dB or more in 99.5 percent of the reliable service area. Moreover, within the mitigation zone (comprising 0.5 percent or less of the coverage area), Northpoint's technology employs a variety of engineering techniques to ensure that DBS consumers are not adversely impacted by these terrestrial operations.

A. Northpoint Technology Can Be Deployed With a Commercially Reasonable Reliable Service Area and a Minimal Mitigation Zone

Because Northpoint is seeking to work cooperatively with DBS licensees, its proposed rules provided considerable flexibility to engineer solutions for DBS/terrestrial sharing taking

[3] Due to confusion apparently generated by Northpoint's use of "exclusion zone," Northpoint's filings utilize the term "mitigation zone" to describe the area where the terrestrial transmitter theoretically could afford less than 20 dB C/I protection to DBS receivers, but where the Northpoint technology and other engineering techniques can be used to mitigate and avoid harmful interference.

into account site specific engineering and propagation considerations. Northpoint sought to define in cooperation with DBS providers, and enumerate through the rulemaking process, a series of principles and operating values from which specifics could be developed. Thus, while a link budget can be prepared for a typical locale, different areas may warrant deployment of a system with higher or lower power, greater or lesser antenna height, beam tilt, or other modifications of transmission characteristics as prescribed by Northpoint's system.[4] Northpoint continues to believe it is necessary to provide significant flexibility within the proposed Section 101.147 to accommodate the unique characteristics of particular areas.

Northpoint never intended such regulatory flexibility to create confusion about the interference mitigation characteristics of its deployed system. Northpoint has always intended to operate its technology in a fashion designed to protect DBS receivers with an acceptable C/I ratio. While Northpoint documented a 4.8 dB C/I as a threshold in its first experimental test, this was not intended to imply that only this level of protection would be afforded to DBS operations under real world conditions.[5] Instead, and in agreement with the comments of Tempo and Echostar,[6] Northpoint believes that 19-20 dB is a good initial target ratio for isolation between

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[4] For example, the Northpoint transmitter (and its mitigation zone) could be located on an antenna farm where no customer DBS dishes are deployed. In other areas, due to the lack of antenna towers or other facilities, engineering a Northpoint system may require a network of lower power transmitters with mitigation zones significantly less than derived in the Texas tests.

[5] The statement of a 4.8 dB C/I ratio was not intended to cause controversy, but rather to be understood as an empirically derived threshold value above which frequency sharing becomes possible. Clearly, reliable co-channel systems would be designed to operate with a much greater operating margin.

[6] Tempo Comments at ¶5; Echostar Comments at 9. Notably, DirecTV has asserted the need for an approximate 35 dB C/I ratio, based on ITU Appendix 30. However, Northpoint believes that 20 dB is a much more realistic criteria, given the conservative nature of the Appendix 30

(Continued...)

Northpoint and DBS signals.[7] Given the robust nature of digital signals, however, it may be possible to improve upon this figure in cooperation with DBS providers.

Northpoint's design easily can meet this 20 dB target. Even in the preliminary King Ranch tests, 97 percent of the reliable service area had 20 dB or greater isolation between the DBS systems.[8] The Technical Annex demonstrates that a typical Northpoint system will naturally provide 20 dB or greater protection automatically to 99.5 percent of the terrestrial reliable service area, even without the use of additional localized engineering techniques. Indeed, this value considers only free space propagation effects, the directional isolation of consumer DBS dishes (based on DBS-provided antenna patterns), vertical isolation of the Northpoint transmitter, and a very conservative estimate of line-of-sight blockage.[9] Clearly, if either the C/I of 20 dB is excessive or the line-of-sight blockage is greater in practice, the

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(...Continued)
calculations and the assumption of analog-to-analog signal interaction, rather than digital-to-digital signal interaction.

[7] A 19-20 dB C/I ratio provides a significant amount of isolation. It essentially requires that the DBS signal is 100 times stronger than the terrestrial signal.

[8] Importantly, the King Ranch tests did not employ any of the interference mitigation techniques available to Northpoint (*e.g.*, higher tower, beam tilt, *etc*).

[9] As explained in the appendix, a significant number of DBS antenna installations will not have line-of-sight to a Northpoint transmitter given the manner in which the antenna is mounted. For example, a DBS antenna mounted on the side of a house with southern exposure will be blocked by the house from line-of-sight to a Northpoint transmitter. While Northpoint estimates only 50 percent blockage, the actual effect of line-of-sight blockage is likely to be significantly higher. Indeed, RCA's dish installation instructions indicate roof mounts, which are more likely to have line-of-sight to a Northpoint transmitter, are only a "last resort" and Sony's installation instructions state "[m]ounting on the roof is also not recommended." *See* http://www.sel.sony.com/SEL/consumer/dss/page8.htm#place.

percentage of customers in the mitigation zone could be reduced to significantly less than 0.1 percent.

As noted above, the basic analysis in arriving at the 99.5 percent figure does not take into account additional available and practical engineering techniques based on local factors. Importantly, such techniques, which are an integral part of Northpoint's technology, could further reduce the mitigation zone:

- ***Increase in Tower Height.*** Northpoint's engineering calculations assume a variety of tower heights. To the extent higher transmitter tower facilities are available, there will be a significant reduction of the isotropic received signal strength ("RSSi") providing additional protection to DBS receivers and further limiting the size of the mitigation zone. The additional protection afforded by the use of higher antenna heights is demonstrated in the engineering exhibit, which shows reductions in the percentage of the coverage area in the mitigation zone.

- ***Attenuation in the Vertical Plane.*** Northpoint's engineering calculations utilize an antenna with a half-power single sided beamwidth of 9°, reflecting the off-the-shelf antenna used in the King Ranch tests. When needed, Northpoint's technology contemplates employing an antenna with further vertical plane attenuation to reduce signal power within the mitigation zone while having minimal impact on the service area. This would provide required protection to DBS signals. Using these techniques of the Northpoint system, the mitigation zone conservatively can be completely eliminated in many metropolitan areas.

- ***Additional "Clear Sky" Margin.*** The rather low percentage of customers in the mitigation zone can be further reduced in many areas of the country where the 11.4 dB clear sky Carrier-to-Noise figure budgeted by DBS providers is excessive. Where an additional 3 dB of clear sky margin is available, the percentage of customers in the mitigation zone would be reduced to only slightly over 0.1 percent, independent of any other mitigation techniques described above.

Northpoint's technology contemplates that these techniques can and will be used in conjunction to limit—or even eliminate[10]—the mitigation zone for specific deployment scenarios. And, as

[10] Indeed, in many major metropolitan areas, such as New York, Phoenix, San Francisco, and Los Angeles, local conditions allow placement of Northpoint transmitters at heights greater than 200 m. At these antenna elevations, there is sufficient attenuation through vertical plane

(Continued...)

discussed below, there are a variety of techniques within the nominal mitigation zone to eliminate interference to specific DBS antennas. These factors demonstrate that deployment of Northpoint systems is commercially and economically feasible without interference to DBS systems.[11]

B. Northpoint Systems Can Employ a Variety of Engineering Solutions Within the Mitigation Zone To Ensure Interference-Free Reception of DBS Transmissions

As discussed above and in the Technical Annex, Northpoint's system can be deployed on an interference-free basis in the vast majority of the terrestrial transmitters' service area. While each service area could have a mitigation zone where sharing becomes an issue, this zone will be a very, very small percentage of the overall service area—0.5 percent or less. Moreover, through judicious site selection, the percentage of the population within the mitigation zone can be reduced well below 0.5 percent. Finally, as discussed below, even within the mitigation zone, Northpoint's technology contemplates the use of a variety of techniques to ensure that terrestrial transmitters do not interfere with DBS reception.

(...Continued)
discrimination, beam tilting, and path loss to maintain a constant RSSi below critical levels throughout the entire service area—allowing complete DBS/Northpoint sharing without any mitigation zone.

[11] Clearly, the assumptions made in some comments regarding the link budget, availability, and commercial feasibility of Northpoint's system are not accurate. Northpoint's system, for example, is engineered to 99.7 percent reliability in ITU rain region E with a rain margin of only 1.6 dB, rather than the 12.8 dB assumed by one commenter. Moreover, because 75.2 percent of the U.S. population lives within Census-defined urbanized areas that constitute only 2.5 percent of the U.S. land area, Northpoint could nominally cover three quarters of the U.S. population with less than 800 transmitters comparable to the system described in the exhibit. In comparison, there are over 1,000,000 cellular base stations in operation.

As an initial matter, Northpoint systems will not be deployed in an arbitrary manner, but strategically with interference minimization in mind. In many cases, interference-free operation can be guaranteed through the use of property rights. For example, where the affected area is owned by the terrestrial licensee or the tower owner, it can be assured that no DBS receivers will be present in the mitigation zone. Where this is not possible, siting areas can still easily be identified in which the population density is far lower than the average throughout the service area. Thus, even in a scenario where the mitigation zone may comprise 0.5 percent of the land area, the percentage of the service area population within the mitigation zone can be designed to be far, far less than 0.5 percent of the served inhabitants.

Even if the mitigation zone encompasses areas where some DBS installations are or could be present, Northpoint anticipates that terrestrial licensees—at their own expense—would eliminate interference for those few individual installations using a variety of techniques. In some cases, poorly pointed DBS dishes may simply require repointing or minimal relocation (for example, from the top of the roof to the side of the house). In other cases, an antenna upgrade to a flat plate antenna could be used to provide additional protection to the DBS subscriber. In more extreme cases, RF shielding could also be employed. Thus, there is an array of individualized solutions that can be implemented by local licensees, at their expense, to rectify any of the very few situations where a DBS subscriber's reception could potentially be adversely affected by a Northpoint system.

Northpoint's technology thus assures complete protection for DBS subscribers. Through the various engineering methods embodied in Northpoint's technology, well over 99.5 percent of DBS subscribers automatically will receive interference protection of 20 dB or greater. For the remaining (at most) 0.5 percent of DBS subscribers within the mitigation zone, a variety of

techniques exist to ensure the integrity of the DBS signal. Thus, Northpoint's terrestrial re-use of the 12.2-12.7 GHz band poses no legitimate threat of adverse effect to DBS licensees.

C. The Comments Strongly Underscore the Benefits of Northpoint's Proposed Further Experimental Testing

To the extent that any interference concerns remain, Northpoint believes that they can be allayed by its further system tests proposed for Austin, Texas. Northpoint urges all of the DBS licensees to observe, or even participate in, this second phase of its experimental testing. Obviously, given the time and location constraints imposed on its original experimental authorization, Northpoint's testing was not, and could not have been, all-inclusive. The King Ranch tests, however, did successfully demonstrate the validity of the sharing technique and the promise of Northpoint's technology. Northpoint, obviously, is interested in additional experimental progress precisely to provide further real world validation of its technology and to directly address many of the issues raised by commenters. The record herein thus supports prompt action on Northpoint's pending request for a modified experimental license.

Some commenters, for example, indicate their concern about multipath interference. This is a particular area Northpoint wants to explore through further testing. Multipath occurs only when a signal is reflected off of some other structure and thus indirectly received by a DBS dish. As a practical matter, however, DBS dishes are highly directional, with 32 dB or greater rejection outside of a 20° cone. Because the angle of incidence equals the angle of reflection, for a reflected Northpoint signal to fall within this 20° cone, geometry dictates that the DBS dish would generally be blocked or shielded from the DBS satellite. In any case, given the directivity of the DBS antenna, the dish could potentially be relocated to eliminate potential multipathing. Outside the 20° cone, given the 32 dB attenuation of the antenna and the absorption that occurs

when radio signals reflect,[12] no practical effect on the system is at all likely. Nonetheless, one of the principal reasons that Northpoint seeks to test in Austin is to evaluate fully the effects of multipath created by an urbanized environment.

Thus, while Northpoint takes very seriously any legitimate threat of harmful interference to core DBS offerings, the basic principles of DBS/terrestrial sharing are sound and have been empirically verified. While engineering questions may still exist, these limited questions can be addressed, fully and finally, through Northpoint's proposed further experimental testing.[13] The Commission, accordingly, should move expeditiously to grant Northpoint's requested experimental modification application.

III. NORTHPOINT'S SYSTEM IS CO-PRIMARY WITH PROPOSED NGSO FSS USE OF THE 12.2-12.7 GHz BAND

SkyBridge, a proponent of an NGSO FSS system in the 12.2-12.7 GHz band (among other bands), opposes the *Petition*. SkyBridge raises two concerns: (i) that Northpoint may interfere with DBS and, (ii) that Northpoint may interfere with proposed NGSO systems. Given the serious technical concerns about the ability of SkyBridge or any NGSO to share spectrum with DBS operations, it is ironic, to say the least, to observe SkyBridge championing interference-free operations of DBS systems in the band. The Commission need not concern itself with SkyBridge's attenuated concern, however ephemeral, for DBS operations.

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[12] While the absorption varies depending upon the surface reflecting the signal, the types of materials found in residential areas where the majority of DBS dishes are located (*e.g.*, wood, brick) generally have high absorption factors.

[13] Certainly, further testing should not be opposed on the Catch-22 grounds that the parameters Northpoint seeks to test have not already been tested.

SkyBridge's second argument is equally flawed. Showing its true intentions, SkyBridge reverses a prior position that it would not impose technical or operational constraints on co-frequency operations and other claims for interference-free sharing throughout the Ku band. Instead, SkyBridge now asserts that Northpoint "almost certainly" will cause interference to proposed NGSO FSS operations. As a result, SkyBridge requests that Northpoint's proposed terrestrial fixed service (FS) and terrestrial broadcast service (BS) operations be made secondary to NGSO FSS. SkyBridge's arguments are misplaced for three distinct reasons.

First, SkyBridge's claim of interference is unsupported by any analysis or evidence whatsoever. It is noteworthy that although SkyBridge critiques Northpoint's technical showing, its filing merely asserts – without proof – that it will receive harmful interference from Northpoint. Moreover, the sparse technical data provided merely demonstrates SkyBridge's utter lack of understanding of even the fundamental technical characteristics of Northpoint's technology.[14] SkyBridge's apparent lack of familiarity with antenna receive characteristics seriously calls into question its ability to develop and operate, on an interference-free basis, the complicated satellite system it proposes.

Second, SkyBridge misrepresents the relevant international spectrum allocations. The international spectrum table for the 12.2-12.7 GHz band contains primary allocations for both fixed and broadcasting services, as well as for the broadcasting-satellite service. Northpoint's

[14] For example, on page 15 of its comments, SkyBridge questions Northpoint's engineering on the ground that Northpoint's experimental results yielded differing results for DirecTV and Echostar. However, the interference characteristics of each system stem from the system azimuths viewed from any terrestrial receiver, which vary from system to system. Northpoint expected such variances, and specifically designed its system to protect the most sensitive DBS receiver.

proposed offerings will include both fixed and broadcasting service but, however classified, its operations are co-primary in the band. Northpoint's fixed and broadcast services also are co-primary with NGSO FSS in Region 2, as a result of the S5.487A footnote added at WRC-97. Thus, under the ITU treaty, any NGSO use of 12.2-12.7 GHz, including by SkyBridge, would be co-primary with terrestrial FS and BS operations such as that planned by Northpoint.

To ensure continued interference free operations, Northpoint has now become active in the U.S. Joint Technical Group 4-9-11, which is examining the WRC-97 provisional power flux density (pfd) limits placed on NGSO operations in the band. The goal of Northpoint, and of this group, is to seek means for harmonious co-existence of systems in the 12.2-12.7 GHz and other bands. Northpoint is now in the process of evaluating provisional pfd limits to ensure co-existence of fixed and broadcast systems with NGSO FSS. However, in any event, Northpoint's system is co-primary with NGSO FSS operations under international law.

Third, SkyBridge asserted domestic policy that might make Northpoint's system secondary to NGSO operations in the U.S. is wholly imagined. Northpoint's FCC *Petition* seeks an allocation secondary only to BSS operations in the band, as required by international footnote S5.490.[15] Contrary to the assertions of SkyBridge, this does not imply that Northpoint's system would be secondary to NGSO FSS as well. SkyBridge provides no basis under FCC regulation or policy to support any different conclusion.

Indeed, as a matter of domestic policy, SkyBridge's comments in this proceeding are the best evidence yet that its proposed system is flying under the false colors of supposed

[15] Northpoint also proposes to protect pre-existing point-to-point Fixed Service licensees in the band.

interference-free operation. SkyBridge represents in its application that it "will impose no operational constraints on satellite and terrestrial operators."[16] Under the circumstances, SkyBridge has no basis for commenting in this proceeding, much less claiming complete interference protection from Northpoint or any other fixed or broadcasting service in the band. Alternatively, if SkyBridge cannot really share the spectrum with other co-primary services, it should be required to file a major amendment to its application noting with specificity the operational constraints that it seeks to impose on terrestrial operators.

IV. CONCLUSION

As documented in the attached Technical Annex, Northpoint transmitters can co-exist on an interference-free basis with DBS systems. In over 99.5 percent of the reliable service area of such transmitters, protection of 20 dB or more – the sufficient level of protection identified by the DBS licensees themselves – occurs automatically. The use of Northpoint technology's additional specialized, yet eminently practical, engineering techniques can reduce any remaining mitigation zone even further. Finally, for those rare cases where the potential for a received signal strength offering less than 20 dB protection is possible, an array of interference prevention solutions is available – at terrestrial licensees' expense – to eliminate completely harmful interference to DBS customers.

The initial testing of Northpoint's technology has already proven the legitimacy of its core sharing technique. The additional real world tests contemplated in its pending experimental modification application will serve to allay any remaining interference concerns. Accordingly,

[16] SkyBridge L.L.C. Application, 89-SAT-AMEND-97 at 22.

given the substantial public interest benefits likely to result from Northpoint's system—the only available means for enabling DBS providers to compete fully with cable television services—the Commission should promptly initiate a rule making to facilitate the deployment of this valuable technology to the American public.

Respectfully submitted,

NORTHPOINT TECHNOLOGY

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May 5, 1998

Technical Annex to Reply Comments

Prepared by Bob Combs & Associates
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Submitted To: Federal Communications Commission
Date: May 5, 1998

Technical Annex to Reply Comments of Northpoint Technology

Overview.

Section 1. Preliminary interference analysis.

Section 2. Interference mitigation through directional broadcast, transmit site selection, vertical plane attenuation, beam tilting and tower height.

Section 3. Other interference mitigation techniques.

Section 4. Improvement of conservative assumptions.

Section 5. Conclusion.

Appendix. Link budgets, sample calculations.

Overview

The purpose of this annex is to demonstrate how Northpoint can operate while protecting DBS systems. Northpoint can provide service to its customers and remain below the interference levels of DBS systems because of the technical and operational characteristics of both systems. Using C/I values proposed by the DBS industry to derive required maximum received signal strength (referenced to an isotropic antenna) or RSSi values, this Technical Annex identifies the potential for sharing between Northpoint's technology and DBS providers and shows interference to be minimal and – through the use of simple engineering techniques – eliminated altogether.

C/I ratio. Interference to DBS could arise when a Northpoint signal is above a certain C/I ratio. Two respondents (Tempo, Echostar) proposed that the C/I ratio should be 19-20 dB or above. Northpoint believes that a lower C/I value would not cause interference to DBS, see the discussion in Section 4 below. This annex will show how Northpoint will meet or exceed the 20 dB C/I interference ratios suggested by the DBS providers.

RSSi values. For purposes of this analysis, Northpoint has used data provided by the DBS industry where possible, with the conservative values used in favor of protecting the DBS systems. Given this, the RSSi of the Northpoint signals must be below -127.9 dBWi, depending on the azimuth of the DBS system to the Northpoint system (as prescribed in the Northpoint Technology).

Fundamental Sharing Point. The fundamental sharing point that allows Northpoint and DBS operations to coexist is the margin between the minimum required Northpoint RSSi and the maximum allowed interference levels to DBS. The Northpoint required RSSi at the edge of coverage is approximately -160 dBWi, including about 5 dB of margin for rain, atmospherics, fading and pointing losses. This level is lower than a level that will interfere with DBS systems. Maintaining the RSSi between the two boundary conditions is feasible, as this annex will show. Thus, with this fundamental sharing point, Northpoint can serve its customers while protecting DBS operations.

This sharing will be accomplished in three ways. First, merely taking account of the off-axis discrimination of DBS receive antennas reduces the potential universe of affected DBS subscribers to less than 1 percent. This is addressed in Section 1, below. Second, Northpoint plans to employ vertical plane attenuation, beam tilting and increased tower height, the combination of which will reduce the universe of affected DBS subscribers to zero for most typical Northpoint installations. This is addressed in Section 2, below. Finally, even if a few subscribers in fact receive inadequate protection (where the topology of the site differs substantially from a typical site), Northpoint licensees will upgrade or relocate DBS customer antennas to eliminate any concern. This is addressed in Section 3, below.

Section 1. Preliminary interference analysis.

Introduction. This section examines the baseline potential for interference for the Northpoint system. The section first address interference with DBS systems *before* considering the gain of DBS receive antennas in the horizontal plane. However, a key feature of the Northpoint Technology takes account of the off-azimuth discrimination of DBS antennas. The preliminary interference budget assumes a typical planned Northpoint transmitter with a 16 km diameter service area. A number of conservative assumptions were used to develop this initial interference budget, which is presented in the annex.[1]

Use of unrealistic assumptions about DBS antenna gains. Some of the DBS providers have suggested, as a preliminary matter, examining interference into DBS receivers with a 0 dBi gain. As shown below, such receivers only have 0 dBi gain in a relatively narrow portion of the horizontal pattern. This is almost always *not* the direction from which the Northpoint transmissions will originate. Nevertheless, for clarity, this analysis begins with that assumption.

Using the 0 dBi gain figure, DBS receivers within the Northpoint service area are protected by a C/I of 20 dB or greater outside a 2.5 km distance from the terrestrial transmitter. Because the ratio of affected area to the service area varies as the square of the distance ratios, only a small portion [$(2.5 \text{ km}/16 \text{ km})^2 = 2.4\%$] of the service area would potentially be below a C/I ratio of 20 dB. This analysis is depicted graphically in Figure 1-1, showing that, without considering DBS off-axis rejection, Northpoint transmissions would not interfere with any DBS receivers more than 2.5 km from the transmitter.

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[1] See the appendices for a discussion on the various engineering assumptions of this interference budget.

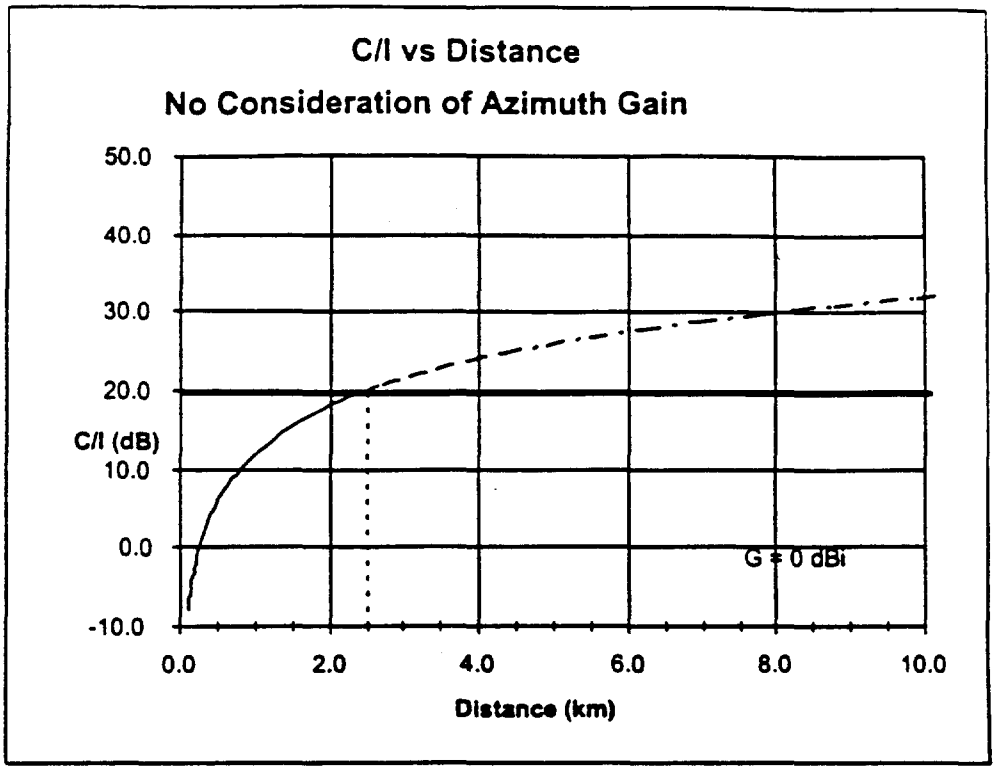

Figure 1-1

In fact, as noted above, this analysis ignores the gain of the typical DBS system towards the horizon. Taking additional discrimination of the DBS antenna into account, the next sub-section shows that less than 1.0% of the DBS service areas would be within a mitigation zone.

Consideration of Horizontal Gain Pattern of DBS antennas. The typical DBS gain in a horizontal direction[2] varies between -16 and 0 dBi. A DBS industry reference provides an excellent antenna pattern derived by the DBS industry from actual testing.[3] This

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[2] It is important to note that the DBS antenna pattern depicted accounts for the feed horn spill over several respondents cited in their objections.

[3] "This horizon gain characteristic is substantially unchanged for beam peak orientations between elevation angles of 20° to 50°." Terrestrial Interference in the DBS Downlink Band, An Analysis Submitted to the FCC April 11, 1994, page 11, Pattern page 10. DBS installations for elevation angles outside of these values would require further study, but are not expected to be significantly different from the results presented herein. Additionally, this analysis shows an antenna pattern towards the horizon of a typical 18" (45 cm) dish shows antenna discrimination of between 35 and 50 dB relative to peak gain of 34 dBi, for a horizontal gain of between -16 and -1 dBi, see the figure in the text. These figures are valid for elevation angles to the DBS satellites of between

(Continued...)

antenna pattern was modeled and the representation of the antenna pattern is seen in Figure 1-2.

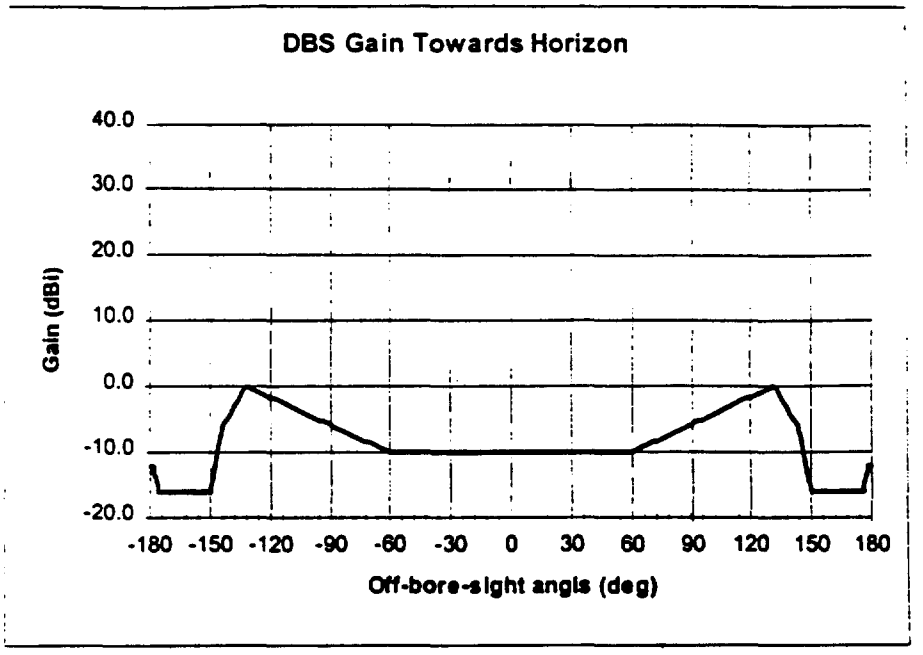

Figure 1-2 - DBS Horizontal Antenna Pattern.

As can be seen, the center of the pattern, (in the horizontal plane) there is substantially less gain than 0 dBi. Considering the gain as a function of azimuth, and using the data from Figure 1-2 above, there will be substantial off-azimuth rejection of Northpoint transmissions:

- about 14% of the DBS azimuth is below -15 dBi;
- an additional 42% is below -9 dBi;
- another 28% is below -3 dBi;
- and the remaining 16% is below 0 dBi.

As a result of the off-axis discrimination of DBS receive antennas, the potential interference distance at the proposed C/I levels is substantially decreased, as seen in Figure 1-3.

(...Continued)
20 and 50 degrees, which are typical values for DBS subscribers in CONUS.

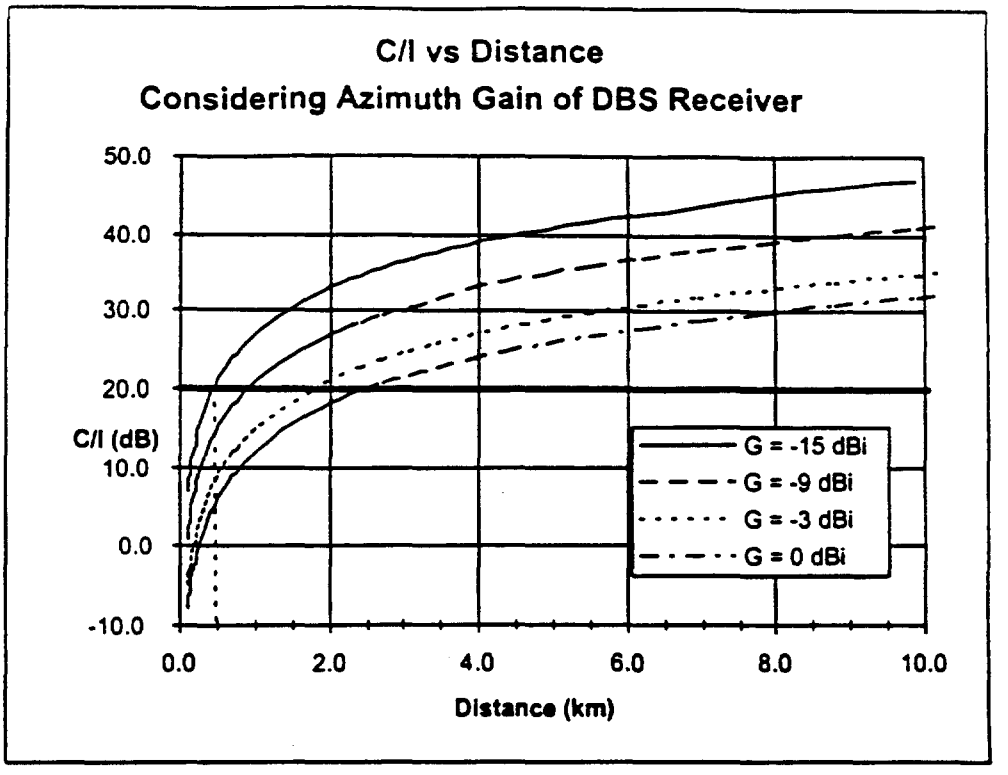

Figure 1-3

In Figure 1-3, DBS users whose receive antennae are pointed substantially away from a co-frequency terrestrial transmission now fall outside the mitigation zone. Accounting for variations in DBS antenna discrimination would result in ensuring an acceptable C/I value as close to the Northpoint transmitter as 0.5 km.[4]

Using the Northpoint Technology, the vast majority of DBS users' receive antennas will be pointed away from the Northpoint transmitter. Table 1-1 uses the above percentages in calculating the actual effect on the size of the mitigation zone for all users, given the specific point geometry of their receive dish:

[4] Figure 1-3 is valid on the boresight of the Northpoint transmitter, at zero meters above ground level, without accounting for horizontal discrimination of the Northpoint transmitter, nor any interference mitigation techniques. These will be discussed in sections 2 and 3 of this report.

Table 1-1. Percent of service area in potential mitigation zone

DBS Horizontal Antenna Gain.	dBi	0.0	-3.0	-9.0	-15.0	Total
Maximum RSSi Allowed (C/I = 20 dB)	dBWi	-142.9	-139.9	-133.9	-127.9	
Minimum Separation	km	2.5	1.8	0.9	0.5	
Service Area (uncorrected)	%	2.5%	1.3%	0.3%	0.1%	
Relative Percent of Horizontal Azimuth	%	16.0%	28.0%	42.0%	14.0%	100%
Percent of Service Area Affected	%	0.40%	0.35%	0.13%	0.01%	0.9%

Thus, simply by accounting for azimuth of the DBS antenna, the size of any mitigation zone is decreased dramatically: less than 1% of customers in the service area of a Northpoint transmitter could potentially be affected by interference. A visual representation of the relative sizes of the interference zones and service areas is depicted in Figure 1-4, which shows the relatively small size of any potential 1 km mitigation zone.

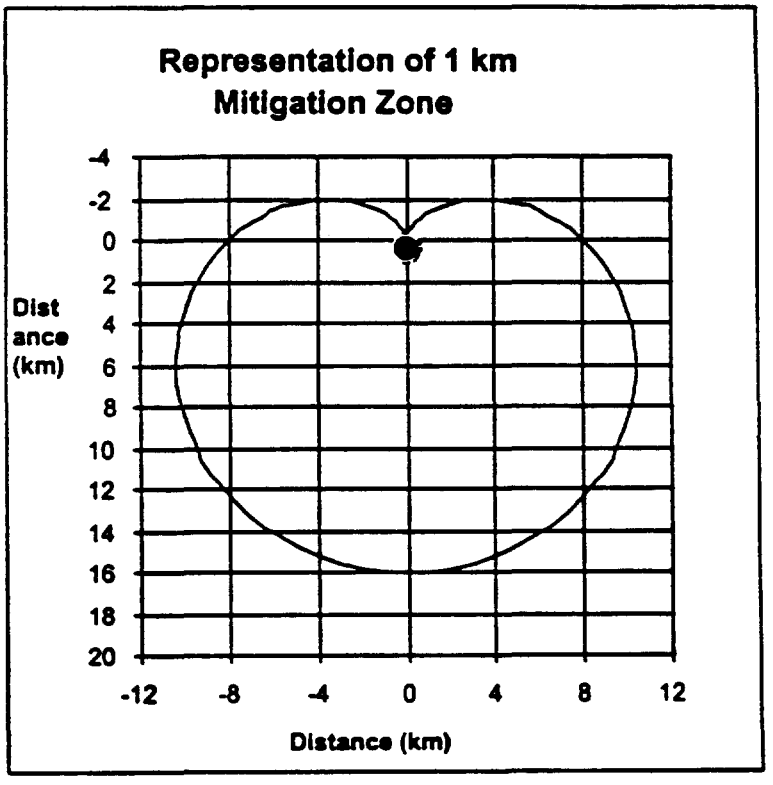

Figure 1-4